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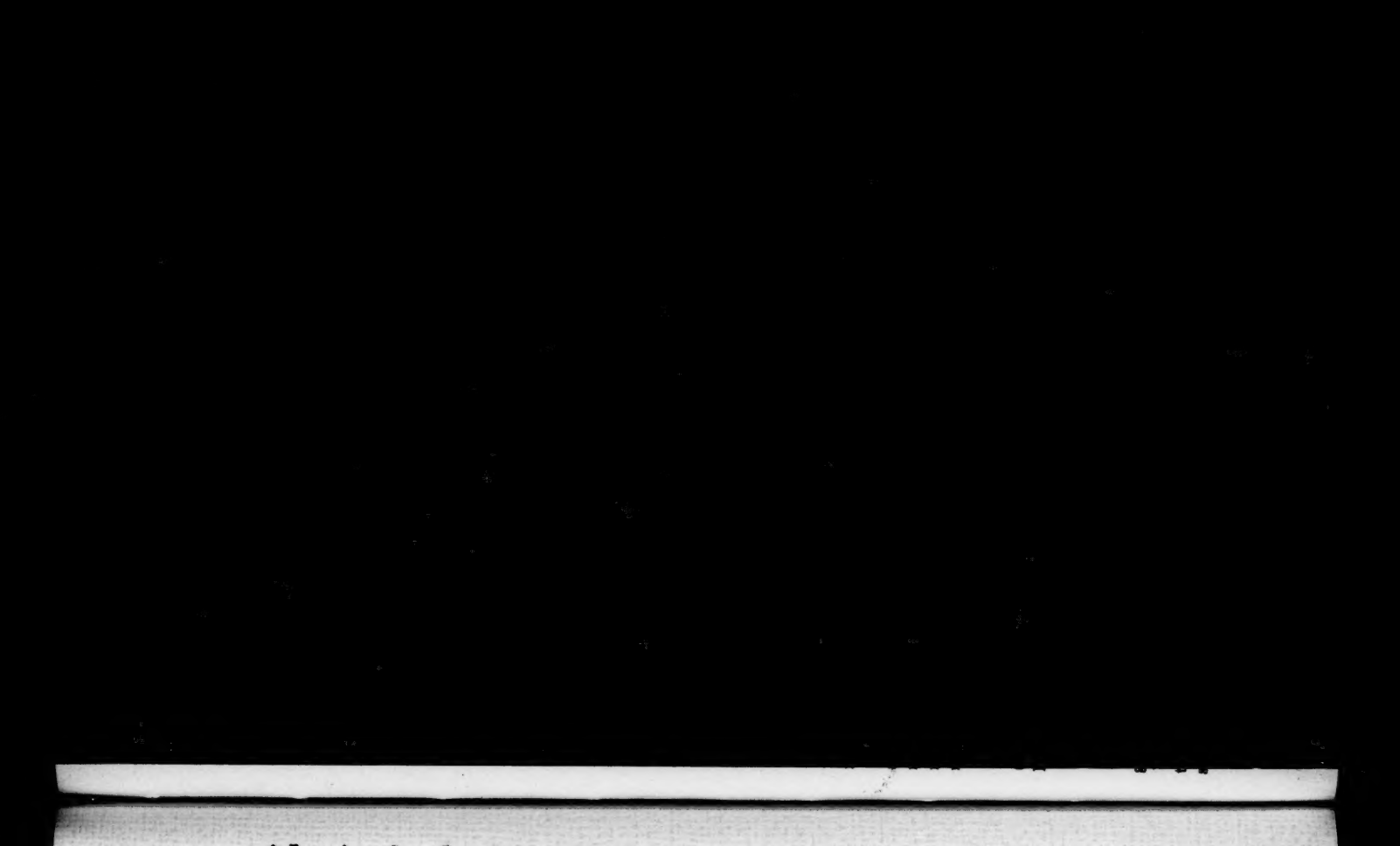

Kansas Entomological Society
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NEW NORTH AMERICAN MUSCOID DIPTERA

H. J. Reinhard
College Station, Texas.

(Continued from July issue)

Sarcophaga siccana, n. sp.
Fig. 20

Very similar to **S. litorosa**, differing only in the following characters:

Male.—More heavily pollinose or grayer in general aspect; front at vertex 0.20 of head width; antennae subequal length of face, third segment over twice length of second; cheeks with heavy cinereous pollen becoming yellowish above; prescutellar bristles absent; anterior acrostichals four, moderately large; hind femur with only a partially developed median row of bristles on outer side before apex; mid tibia with one anterodorsal bristle; wings hyaline, third vein with three to five hairs near base; calypters glassy white with a light brownish shade at middle of hind lobes; abdominal pollen with a distinct yellowish sheen on segments three and four, the latter showing an obscure reddish tinge in ground color.

Hypopygium rather small; first segment mostly red becoming darker at base, pale pollinose above, with an interrupted row of good-sized bristles before hind margin; second segment subshiny red, sparsely haired on upper surface; forceps red, rather narrow in profile on basal part, which bears a tuft of long hairs behind, widening to middle thence tapering rapidly to a short acute beak; penis with a short reddish basal stalk; distal segment enlarged, subquadrate in profile with a deep median emargination on posterior side; viewed from behind the hollow interior surface of the segment contains a minute median and a pair of delicate lateral processes which are not visible in profile; both claspers small; accessory process short and narrow.

Female.—Front 0.30 of head width, narrowest at vertex; the usual orbitals and outer verticals present; ocellars rather stout; apical scutellars absent; mid tibia with two anterodorsal bristles; last abdominal segment wholly red, with deep yellow to golden pollen; genitalia red, first segment prominent, evenly arched above and enclosing a flat subtriangular sternite below.

Length, 10.5-12 mm.

Holotype: Male, Sunnyside Canyon, Huachuca Mts., Arizona, July 9, 1940 (D. E. Hardy), in the Snow Entomological Collections, University of Kansas. Paratype: 1 female, Santa Rita Mts., Arizona, May 31, 1946 (R. Bohart).

Sarcophaga vernilis, n. sp.
Fig. 21

Very close to **S. ampulla**, but with decisive differences in the male genitalia.

Male.—Front at vertex 0.21 of head width, slightly narrowed downward thence widening evenly into facial angle; parafrontals and parafacials silvery, the latter with a row of small hairs along outer margin; frontal

rows feebly divergent at antennae, one bristle beneath base of same; outer verticals differentiated; ocellars moderately large; antennae black, third segment two and one-half times second, reaching nearly to vibrissae, which are on oral margin; facial ridges setose to middle; arista moderately long plumose to middle or beyond; cheeks one-fourth eye height, with thick gray pollen and black hairs intermixed with pale ones on lower edge; proboscis short but not very stout, palpi black, normal in size; occiput with two rows of black hairs on upper margin and below latter wholly pale pilose.

Thorax rather densely gray pollinose, with three to five black vittae above; anterior acrostichals vestigial, prescutellars well developed; postsutural dorsocentrals three; sternopleurals three; scutellum with three lateral, no apical and one preapical pair; propleura and prosternum bare; postnotal slopes setose.

Legs black; hind tibiae not villose, middle pair with one stout and usually one small anterodorsal bristle; middle femur with a few stubby spines on apical posteroventral edge; claws and pulvilli moderately long.

Wings hyaline; costal spine small; first and third veins setulose; last section of fifth vein one-third length of preceding; calypters white.

Abdomen with rather thick gray pollen, tessellated, apical margin of fourth segment orange red; third segment with one pair of median marginals besides one or two laterals; anal segment with a complete marginal row; fifth sternite with a wide U-shaped apical incision, lobes small and largely retracted, inner margin of same clothed with pale pubescence and a fringe of delicate black hairs.

Hypopygium small, both segments red but first darker at middle of basal margin above, this area somewhat pruinose; forceps black, moderately long, somewhat constricted before apex, which is obtusely toothed behind and obliquely prolonged on anterior extremity; penis stalk red and rather short; apical segment enlarged, subovate in profile, brownish behind and partly translucent white on swollen front side, which bears a shallow emargination before the apex; in direct view the distal extremity of the segment is almost circular, hollow, and contains a number of very minute processes aside from the copulatory tube, which alone protrudes sufficiently to become visible in lateral aspect; accessory process small, brownish black; front claspers with a broad heavy base, curved and narrowed apically; hind claspers smaller, suddenly narrowed near middle, thence very slender ending in delicate curved tips.

Length, 6-9.5 mm.

Holotype: Male, Brewster Co., Texas, July 1, 1937 (C. E. Heard). Paratypes: 2 males, same data as type; and 3 males, Chiricahua Mts., Arizona, July 4, 1940 (R. H. Beamer and D. E. Hardy), in the Snow Entomological Collections, Kansas University.

Sarcophaga sigilla, n. sp.

Fig. 22

Hind and middle tibiae with abundant long hairs, three postsutural

dorsocentrals and hypopygium mostly red. Traces to **S. tetra** in available keys, from which it differs widely in genitalic characters among others.

Male.—Front measuring 0.23 of head width before ocellar triangle and but slightly more at vertex; parafrontals and parafacials pale yellowish gray pollinose, the latter with a row of scanty hairs somewhat scattered above; frontal rows rather strongly divergent anteriorly, two or three bristles below antennal base; ocellars small; outer verticals not developed; antennae black, subequal length of face, third segment twice longer than second; arista long plumose on basal three-fifths; epistoma rather prominent; vibrissae on oral margin; clypeus cinereous, not much wider than parafacial; proboscis short, stout; palpi black, normal in size; cheeks cinerous tinged with yellow above, sparsely black-haired, one-third eye height; occiput moderately bulged, with coarse black hairs above and finer pale ones below.

Thorax gray pollinose, with five to seven black vittae above; anterior acrostichals absent; prescutellar pair moderately long; sternopleurals three; scutellum with two lateral, no apical and one preapical pair; propleura and prosternum bare.

Legs black, hind tibiae somewhat reddish; mid femur without comb; mid tibiae bearing two anterodorsal bristles and less densely haired than hind pair; claws and pulvilli long, the latter brown.

Wings hyaline; costal spine not developed; first vein bare, third setulose over halfway to small cross vein, which is slightly infuscated; calypters white.

Abdomen black with gray pollen which is interrupted by three rather wide and fairly constant black vittae; third segment with one pair of median marginals and one strong lateral; fourth segment reddish on hind edge, the latter bearing a row of moderately long stout bristles; fifth sternite red, lobes small and widely divergent apically, the inner margin at base somewhat widened and thickly beset with stubby spines which extend distally but with finer hairs intermixed before the apex.

Hypopygium large; first segment brown on basal half or more, without bristles; second segment subshiny red, globose, with rather sparse, erect fine hairs above; forceps red on basal half, stout, bowed forward and tapering to acute shiny black tips, the latter slightly divergent in rear view; accessory process triangular, clothed with moderately long pale brown hairs; penis with a very short basal stalk, swollen and white in front; distal segment large, narrowed and curved forward apically with each lateral extremity of the apex moderately produced, immediately in front of the apical claw a pair of membranous processes extend forward to the apex of the same; on the front side near the middle the apical segment bears a pair of articulated triangular plates and basad of latter a larger cone-shaped protuberance, which has the front and apical surface beset with minute stubby spines; both claspers rather small, tapering to narrow tips.

Length, 11 mm.

Holotype: Male, Huachuca Mts., Arizona, July 8, 1932 (J. D. Beamer), in the Snow Entomological Collections, Kansas University.

Sarcophaga prolepsis, n. sp.

Fig. 23

Belongs to Aldrich's Group D, characterized by having three postsutural dorsocentrals, hind tibia not villous and hypopygium at least partly red. The present species apparently is not closely related to any previously described form in the morphology of the genitalia.

Male.—Front at narrowest 0.20 and at vertex 0.25 of head width; parafrontals and parafacials silvery, the latter with a single row of minute hairs on outer margin; frontal rows moderately diverging at antennae, two bristles below base of same; antennae subequal length of face, second segment red, third concolorous near base, two to two and one-half times longer than second; arista moderately long plumose on basal half; outer verticals absent; ocellars normal in size; vibrissae strong, on oral margin; proboscis short, palpi black, rather slender; cheeks cinereous, wholly black-haired, one-third eye height; occiput with three irregular rows of black hairs above, pale pilose at middle and below.

Thorax gray pollinose with five to seven black dorsal vittae; anterior acrostichals small but differentiated; prescutellars small to medium-sized; sternopleurals three; scutellum with two large lateral, one small decussate apical and one preapical pair; propleura bare; prosternum and postnotal slopes setose.

Legs black; mid femur without comb, its tibia with two anterodorsal bristles; pulvilli large, brown, claws long.

Wings hyaline; first vein bare, third haired over halfway to small cross vein; costal spine vestigial.

Abdomen with rather heavy pale gray pollen, showing three fairly constant black vittae in most angles; third segment with a pair of median marginals and three to five at sides; fourth segment with a complete marginal row; fifth sternite red, with inner margin of the lobes at base of the U-shaped incision bearing a very dense vestiture of short black hairs, which become sparser outward but extend almost to apex.

Hypopygium rather small; first segment red tinged with black and pollinose at middle above, several good-sized bristles before hind margin; second segment more shiny, wholly red, without bristles; forceps shining brown, divided on apical three-fifths but not divergent, each prong shallowly grooved behind and bearing a sublateral carina on basal half; viewed in profile the hind margin of the forceps is broadly emarginate near middle thence evenly arcuate to tip; accessory process red, very small; penis with a short triangular basal stalk; distal segment slender in profile, bent rectangularly forward at middle, with a swollen lobe in front, which bears a short upcurved hook at each side on the apical extremity; near the apex behind the segment bears a strong bowed process, which divides apically into two slightly divergent blunt-tipped hooks; posterior forceps rather slender, tapering to sharp curved tips; anterior forceps sharply bowed near base thence strongly compressed to broad tips.

Female.—Like male except for the usual sexual differences. Genital segment rather small, flat at sides leaving a more prominent inverted V-shaped part visible in profile, the margin of the triangular orifice bears a fringe of bristly hairs.

Length, 7-11.5 mm.

Holotype male and allotype female, Chiricahua Mts., Arizona, July 4, 1940 (D. E. Hardy and R. H. Beamer), in the Snow Entomological Collections, University of Kansas. Paratypes: 1 male and 2 females, same data as type; 1 male, Sunnyside Canyon, Huachuca Mts., Arizona, July 9, 1940 (D. E. Hardy) and 1 female, Santa Rita Mts., Arizona, July 19, 1938 (R. H. Beamer).

Sarcophaga spretor, n. sp.

Fig. 24

Resembles **S. prohibita** Aldrich (**Acanthodotheca** Townsend) in all essential details except the genitalia; the latter are strikingly different.

Male.—Front narrower than usual, at vertex 0.18 of head width; parafrontals and parafacials silvery, the latter with a row of small hairs near eye; frontal rows moderately divergent in lower two bristles, which are beneath antennal base; second segment of antennae reddish, third darker, reaching four-fifths the distance to vibrissae, which are slightly above oral margin; arista long plumose on basal three-fifths; palpi red, rather slender; proboscis short, stout; cheeks gray pollinose, black-haired, one-third eye height; occiput pale pilose with three rows of coarse black hairs on upper margin.

Thorax gray pollinose, with five to seven black vittae above; anterior acrostichals well differentiated; prescutellar of medium size; postsutural dorsocentrals three; sternopleurals three; scutellum with two large lateral, one medium-sized preapical and one small apical; propleura with a few minute hairs in front of middle and prosternum with several on lateral edge behind.

Legs black, rather slender; hind tibiae not villose, preceding pair with two anterodorsal bristles; mid femur without comb; claws and pulvilli elongate.

Wings hyaline; costal spine small; third vein haired halfway to small cross vein; calypters white.

Abdomen gray pollinose, tessellated, with three rather distinct black vittae on entire length above; three basal segments without median marginals, fourth with a complete marginal row; fifth sternite mostly reddish, lobes thickly beset with black spiny hairs on apex and bearing a pair of ovate padlike structures on inner margin near base.

Hypopygium large, wholly red; first segment pale pollinose and sparsely fine-haired above, with a row of bristles on hind margin; second segment more shiny, with a heavier vestiture of black hairs, none bristly; forceps red and strongly bowed forward near base, the free part shining brown, divided but not divergent, rather straight in profile, tapering to sharp tips turned forward; accessory process red, gradually narrowed distally and

about twice longer than wide; penis extra large, jointed near base and middle, stalk red, slender; distal segment with a pair of recurved hooks on the hind side and the apex bearing a very large blackish hoodlike lobe, mostly soft in texture; the latter is moderately compressed and bears a vestiture of minute stubby hairs on lateral surface, near the base above a short chitinized process on either side supports a small transparent brown flaplike lobe, which is directed laterally and inconspicuous except in front or rear view; posterior forceps strongly compressed, gently bowed and directed forward from base, emarginate on upper edge before tip; anterior forceps short and inconspicuous, tips broad, obliquely truncate in profile view.

Length, 9.5 mm.

Holotype: Male, Logan, Utah, September 2, 1926 (George Knowlton).

Sarcophaga reperta, n. sp.

Fig. 25

Allied to **S. eleodis** Aldrich (**Eleodiomyia** Townsend) in genital features, but considerably larger and more robust in build.

Male.—Front at vertex 0.21 of head width and but slightly narrowed before ocellar triangle; parafrontals and parafacials silvery, the latter with one or more rows of small hairs near eye margin; frontal rows moderately divergent anteriorly, two beneath antennal base; ocellars normal in size, outer verticals absent; antennae reaching to lower fourth of face, second segment yellow apically, about half as long as third; arista long plumose on proximal three-fifths; vibrissae slightly above oral margin; facial ridges setose nearly to middle; proboscis short; palpi blackish, moderately long; cheeks cinereous, black-haired, barely one-third eye height; occiput pale pilose with three rows of black coarser hairs along upper margin.

Thorax gray pollinose, with five to seven black vittae well defined before suture; postsutural dorsocentrals three; anterior acrostichals well developed; prescutellars moderately large; sternopleurals three; scutellum with three lateral (intermediate one small), one preapical and one small decussate apical pair; propleura and prosternum sparsely haired.

Legs black; mid tibiae with two anterodorsal bristles, hind pair not villose; mid femur with comb; pulvilli large, brown.

Wings hyaline; costal spine small; first vein bare, third setose halfway to small cross vein; calypters opaque white.

Abdomen with rather heavy gray changeable pollen and showing the usual three shifting black vittae; third segment with one pair of median marginals, fourth bearing a complete marginal row; fifth sternite red, the lobes small and nearly contiguous along median incision, narrow apex of each lobe densely beset with stiff spiny hairs.

Hypopygium large, wholly red; forceps with a large flattened protuberance at base behind, thence deeply notched in profile, the distal part moderately wide and bowed forward, with minute spines on hind surface except at middle; accessory process pale red, large, convex on outer surface,

tapering apically to a blunt tip; penis with a short red basal segment; the apical one concolorous, somewhat thicker, with a pair of long recurved hooks near apex behind, from the base of the latter two slender divergent processes curve back thence inwardly under a somewhat thicker pair situated nearer to the anterior extremity of the segment; on the front side the segment bears a prominent lobe which appears attached on its distal half, but free and sloping obliquely forward towards base of the stalk; posterior claspers angularly bowed near base behind, strongly compressed on entire length, tapering to narrow tips; anterior claspers pale yellow, with a broad stout base, the short narrowed distal part curved forward and inconspicuous in profile.

Length, 11-12.5 mm.

Holotype: Male, Strawberry Mt., 8600 ft., Grant Co., Oregon, August 23, 1932 (D. K. Frewing). Paratypes: 1 male, Antelope Mt., 5000 ft., Grant Co., Oregon, August 8, 1932 (D. K. Frewing); 1 male, Roy, Washington, May 18, 1935 (J. Wilcox); and 1 male, "California, August 19, 1936." Three males in the Snow Entomological Collections, from California as follows: Cajon Pass, August 6, 1936 (M. B. Jackson) and Mt. Springs, July 25, 1938 (Jean Russell); and 1 male, Lone Pine, July 28, 1940 (R. H. Beamer).

Sarcophaga complosa, n. sp.
Fig. 26

Male.—Characters like those of **S. reperta** except as follows: Front at vertex 0.24 of head width; vibrissae somewhat approximated and well above the oral margin; fourth abdominal segment usually reddish on hind margin; fifth sternite black, the lobes well separated, with inner margin of each near base of cleft bearing thick wedge-shaped process directed downward and prominent in profile; on the hind side these processes are flattened, pale in color and bear a sparse vestiture of ordinary fine black hairs.

Hypopygium smallish to moderate in size, red with first segment at times tinged with black on basal half above; forceps bulged at base in profile with deep incision immediately below, thence bowed back with the shining black free part spinose behind, rather short and broad curving forward to a sharp tip; viewed from the rear the forceps are widely separated and bear a sharp carina for their full length on the inner side; penis stalk red, the basal segment very short; apical segment with a pair of recurved hooks on hind side before apex and a simple slender process at each lateral extremity; on the front side the segment bears a pair of large articulated lobes, which are extended laterally on the apical margin in the form of thin brown earlike flaps, between the latter a separate and peculiar setose lobe extends obliquely forward and downward, in distal view the apical margin of latter is thin and inverted V-shaped; both claspers rather small, the anterior one more curved and stouter at base.

Length, 10.5-12 mm.

Holotype: Male, Mt. Springs, California, July 25, 1938 (Jean Russell), in the Snow Entomological Collections, Kansas University. Paratypes: 1 male, same data as type; 3 males from Arizona as follows: Tucson Mts., June

18, 1933 (R. H. Beamer), Santa Rita Mts., July 17, 1932 (R. H. and J. D. Beamer).

Sarcophaga conabilis, n. sp.

Figs. 27, 27A

Allied to **S. sulculata** Aldrich (**Zygastropyga** Townsend) but at once distinguished in the male by the much smaller hypopygium and the decisively different genitalia.

Male.—Front broader than usual, at vertex 0.30 of head width and equibroad to antennae; parafrontals and parafacials subsilvery, the latter with delicate hairs on outer margin; frontal rows only slightly divergent anteriorly, one bristle below antennal base; frontal vitta wide, rather heavily gray pollinose; verticals two pairs, well developed; orbitals absent; ocellars normal in size; antennae three-fourths length of face, second segment bright red, third blackish, about twice as long as second; arista moderately long plumose on basal half; vibrissae strong, near oral margin; cheeks heavily gray pollinose, black-haired, nearly two-fifths eye height; proboscis short, stout; palpi black, ordinary in size; occiput with coarse black hairs on most of upper half, a few pale ones around the neck and at middle below.

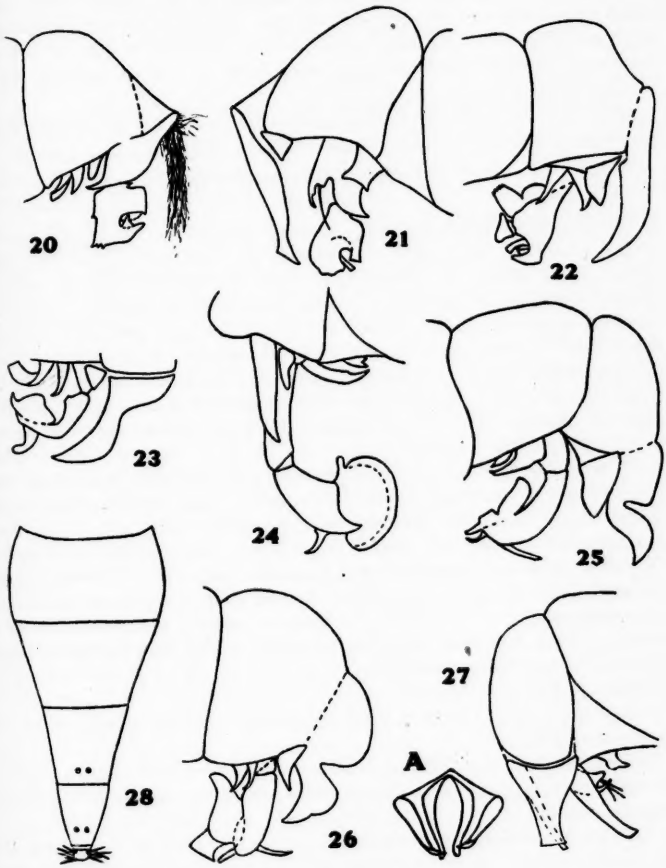
Thorax gray pollinose with three to five dark vittae above, the three median ones widest and showing a distinct brownish tinge in most views; anterior acrostichals two, well developed; prescutellars one, smallish but distinct; postsutural dorsocentrals four; sternopleurals three; scutellum with two lateral, no apical and one subdiscal pair; propleura, prosternum and postnotal slopes sparsely setose.

Legs black; hind tibiae with several long erect hairs on inner side, the preceding pair bearing one stout and one small anterodorsal bristle; mid femur without comb; claws and pulvilli elongate.

Wings hyaline; first vein bare, third setulose nearly to small cross vein; costal spine minute; calypters opaque white.

Abdomen gray pollinose with three rather distinct dark vittae above; third and fourth segments each with a marginal row of good-sized bristles; fourth segment red on narrow hind margin; fifth sternite with a broad U-shaped apical incision, the lobes small, reddish and sparsely clothed with fine hairs along inner margin.

Hypopygium moderately large, red, the first segment largely retracted, bare above except on darker hind margin, which bears a row of longer bristly hairs intermingled with smaller ones; second segment larger, slightly pruinose, sparsely clothed with short erect hairs; accessory process red, extra large and in lateral view covering the forceps except at their extreme tips; in rear view the forceps are rather widely separated, slender and gently bowed inward apically, tips bluntly rounded; posterior clasper shiny brown, also unusually large, directed obliquely forward and tapering gradually to a blunt tip; anterior clasper pale yellow, with a stoutish base thence narrowed into small forwardly directed hooks; penis short, bowed forward from base, emarginate at apex, the upper lobe of latter heavier and soft



Lateral View of Male Genitalia

Plate III

Figure 20. **Sarcophaga siccana,** n. sp. Male genitalia lateral view.
Figure 21. **Sarcophaga vernilis,** n. sp. Male genitalia lateral view.
Figure 22. **Sarcophaga sigilla,** n. sp. Male genitalia lateral view.
Figure 23. **Sarcophaga prolepsis,** n. sp. Male genitalia lateral view.
Figure 24. **Sarcophaga spretor,** n. sp. Male genitalia lateral view.
Figure 25. **Sarcophaga reperta,** n. sp. Male genitalia lateral view.
Figure 26. **Sarcophaga complosa,** n. sp. Male genitalia lateral view.
Figure 27. **Sarcophaga conabilis,** n. sp. Male genitalia lateral view.
27A, forceps and accessory processes in rear view.
Figure 28. **Sarcophaga compressa,** n. sp. Abdomen of female in dorsal view.

in texture, bearing three pale brown bristles on the lower apical edge, which extend forward between the diverging sharp tips of the more strongly chitinized hind part, the latter is divided on the median line for half the distance to the base, each part thin or bladelike as viewed from the rear.

Length, 9-9.5 mm.

Holotype: Male, College Station, Texas, March 21, 1945 (H. J. Reinhard). Paratype: 1 male, same data except dated May 15, 1943.

Sarcophaga compressa, n. sp.

Fig. 28

Female.—With abdomen very strongly compressed and consequently unusually narrow as viewed from above. The remaining characters seem ordinary and similar to **Sarcophaga**, where the species may be assigned pending discovery of the male. Front at vertex 0.32 of head width gradually widening to antennae; parafrontals and parafacials gray pollinose, the latter with a row of coarse hair on outer margin; frontals moderately diverging in two bristles below antennal base; two strong orbitals and verticals; antennae three-fourths facial length, second segment red on apex and about one-half length of third; arista moderately long plumose on basal half or more; vibrissae stout, slightly above oral margin; cheek grooves red, this color extending upward to include inner half of parafacial to antennal base; palpi rather slender, black; proboscis short; cheek with gray pollen and coarse black hairs, one-third eye height; occiput with sparse pale hairs at middle below extending upward around neck thence wholly black-haired.

Thorax gray pollinose with five to seven black dorsal vittae; anterior acrostichals small but distinct; prescutellars moderately large; postsutural dorsocentrals three; sternopleurals three; scutellum with two lateral, no apical and one subdiscal pair; propleura practically bare; prosternum and postnotal slopes faintly haired.
moderately long.

Legs black; mid tibia with two anterdorsal bristles; claws and pulvilli moderately long.

Wings hyaline; costal spine small; first vein bare, third setose nearly to small cross vein; venation ordinary, veins including costa yellow; calypters opaque white.

Abdomen strongly compressed and tapering sharply to apex from base of second segment, in profile unusually deep and moderately arched above, wholly gray pollinose with a distinct median vitta; three basal segments black, third bearing one pair of erect median marginals besides one or two differentiated laterals; fourth segment wholly red, with one pair of median submarginals and three or four smaller bristles at sides nearer margin; first genital tergite narrowly exposed, with several forwardly curved bristles on sides; two apical sternites shining red, rather long and directed obliquely upward, the last bearing heavy laterally directed spines on each side near apex.

Length, 10 mm.

Holotype: Female, Bexar Co., Texas, June 26, 1931 (H. J. Reinhard).

THE GROUSE LOCUSTS

(Orthoptera; Acrididae: Tetriginae)[1, 2]

ROBERT K. NABOURS
Kansas Agricultural Experiment Station

Several names have been applied by a number of entomologists to the Orthopteran sub-family **Tetriginae**. Linne (1767) used the term **Bulla**, accompanied by unmistakable figures. Scudder (1900), Hancock (1902), and other orthoptologists have employed such words as **Tettix, Tettiginae, Tettigidae** and **Tetriginae**, which were apparently derived from the Greek word "tettix", meaning grasshopper. They are commonly called grouse locusts, probably because of a fancied resemblance to the grouse **(Tetraoninae)**. They are also referred to as the pygmy or swamp locusts.

The **Tetriginae** are among the smallest of the Orthoptera. The extremely developed apical process of the pronotum extends backward over the meso- and metanotum, and either to the end of the abdomen which coincides with the distal ends of the femora of the jumping legs, or considerably beyond. There is a tendency toward rather strict dimorphism with respect to the lengths of the pronotum and wings, although intermediate lengths are sometimes noted. The short pronotum and wings are nearly always the same length while the wings of the long phase protrude slightly beyond the apical end of the pronotum.

The individuals bearing long wings and pronota are able to fly readily and sometimes for long distances. Those bearing short wings and pronota are unable to fly and are thus restricted to jumping and walking movements. Pulvilli are lacking and the tegmina are greatly reduced or absent. They vary considerably in size, even within the species, and enormously within the sub-family. The males are usually conspicuously smaller than the females.

In the **Tetriginae** the caeca have only anterior prolongations, while in the other **Acrididae** the caeca have each a smaller posterior extension as well. The crop is smaller and less rectangular anteriorly than in other **Acrididae** (Hancock, 1902; Robertson, 1915; Nabours, 1929). Other features of the internal structures are noted in the description of the reproductive systems (Robertson, 1915; Harman, 1925; Nabours, 1929).

The color patterns on the pronotum, legs and other parts of the body, even within a species, vary extraordinarily. There are several kinds, colors, and widths of stripes along the median pronotum and on the femora of the jumping legs, eight or ten observed conspicuous spots about the middle of the pronotum, and numerous other patterns. The colors of the patterns vary through white, gray, brown, yellow, mahogany and black and in many shades and combinations. More than 25 elementary dominant patterns and a few recessives have been observed in **Paratettix texanus** Hancock, upwards of

[1]Largely from previous and forthcoming papers by the author and colleagues.
[2]Contribution No. 251, Department of Zoology.

20 in **Apotettix eurycephalus** Hancock, and more than 25 in **Acrydium arenosum** Burmeister (Nabours, 1914, 1917, 1925, 1929; Nabours, Larson and Hartwig, 1933).

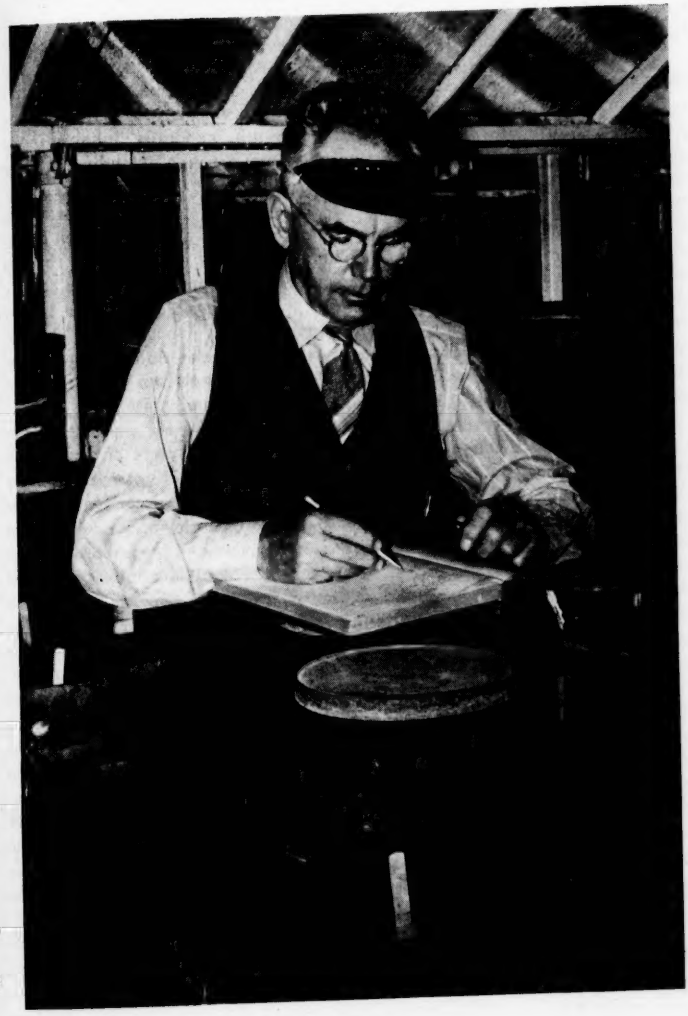
These elementary color patterns totaling more than a hundred so far observed in several species, most of them having been bred in the greenhouse, are, with perhaps less than a dozen exceptions, dominant in their inheritance. No interspecific crossing, following Hancocks taxonomy, has been accomplished. However, there are great possibilities for combining in the inheritance experiments, within the species, the various dominant elementary patterns so that each component pattern may be recognized, with the hybrid pattern still distinctly different (Nabours, 1929, plates III and IV).

Several of the dominant color patterns are repeated in different genera and species. There is a mottled gray-all-over pattern, recessive to most of the conspicuous patterns, common to nearly all of the species studied. It has been designated in the experiments as +/+ (old A). It is now considered the 'wild-type' (Nabours 1925; 1929). The pattern C in **P. texanus** has a counterpart in **Telmatettix aztecus** and **Nomotettix** (sp). The K-stripe of **A. eurycephalus** is almost exactly repeated in **P. texanus** and **A. arenosum.** However, these patterns are generally quite easy to distinguish among the species. There are also differences in the linkage relations of similar patterns in different species. For example, genes for color patterns designated as Y and K in **A. eurycephalus** are linked to the extent of approximately six percent; whereas J and K, their almost precise counterparts in **P. texanus,** exhibit no crossing over. Several other similar cases may be noted among the data (Nabours, 1925, 1929; Nabours, Larson and Hartwig, 1933).

According to Hancock (1902), the distribution of the **Tetriginae** is cosmopolitan for the tropics and the temperate zones. The greater numbers and varieties of species appear to be in the tropics, and more actual species are found in North America than in Europe. Hancock described 99 species for North America and he thought there were more. Hancock's classification has been employed in the extensive experiments at Kansas Agricultural Experiment Station because it has been considered more consistent than revisions which have been suggested.

For example, it has not been found that any of Hancock's species, so far used, would interbreed; whereas others have placed some of his non-interbreeding species in the one species. Hancocks **Paratettix texanus** and **P. cucullatus,** which do not interbreed, have both been placed in the one species and the name **P. cucullatus** retained, and his **Apotettix eurycephalus** and **A. mexicanus** which also do not interbreed have been accorded the designation of **A. mexicanus** (Letters to the author). These species appear to the experienced investigator as also differing in other aspects. However, we have not been concerned with the taxonomy so much as with the use of phenotypes as chromosome markers. This is not to minimize the importance of taxonomy. A thorough revision of the genera and species of the **Tetriginae** is very much to be desired.

Please note that the ill-advised (at the suggestion of others and only



DR. ROBERT K. NABOURS

with Hancock's reluctant acquiescence) attribution of species to color varieties in **Paratettix texanus** by Nabours in 1914 has been definitely repudiated by him (1917) no less than by others.

The grouse locusts commonly inhabit moist areas, usually along the margins of streams, fresh water lakes and ponds. They have not been found by us in salt marshes, or any place affected by sea water. Some species, as **Tettigidea parvipennis** and **Acrydium arenosum**, generally inhabit moist grassy or wooded areas. These two species have a range extending at least from Manhattan, Kansas to San Antonio, Texas, the former having been collected also at Monterrey and Tampico, Mexico. Other species, as **P. texanus, P. cuculatus**, and **A. eurycephalus**, are more frequently found in open areas, along the algae-covered margins of ponds, especially as the water recedes in the summer and fall. The one conspicuous exception has been the collection of **P. texanus and A. eurycephalus** in considerable numbers in the rather densely wooded area along the north shore of Chicon Lake, 30 miles west of San Antonio, Texas. They were there on three different occasions, two and three years apart, along with **Acrydium arenosum** and **Tettigidea parvipennis** which were, as stated above, in their normal habitat.

The grouse locusts feed mainly on the various algae growing on the moist soil or the filamentous algae left by receding waters of ponds and lakes. However, with all our experience, it has not been ascertained whether the living algae supply nourishment or that the accompanying decayed algae and other vegetable matter and humus, fungi, bacteria, and protozoa are utilized. Breakfast foods, fruits and other materials have been tried without avail. Algae in various stages of life and decay are made available to them in the breeding cages. It has been noted that when green algae was fed to them the fecal pellets tended to be still quite green. None of the individuals of the species of the **Tetriginae** used in the experiments has eaten grass or higher plants to any extent.

The northern grouse locusts (generally from a line somewhat south of the Ohio, lower Missouri and Kansas Rivers) produce approximately one and a half generations a year, with only one along the northern U. S. A. border. The cold weather, arriving in October-December, catches them as adults and in various nymphal stages, and they all go into hibernation for the winter. They get into tufts of grass, under leaves, stones, and pieces of wood and often remain completely exposed. They probably receive little protection from the weather. They have been known to endure subzero weather. The mortality during the winter is high, due perhaps as much to desiccation as to low temperatures.

There is no regularity about their going into or emerging from hibernation. They do not become inactive until the cold weather actually arrives, and they become active again during warm periods. During unseasonable, early warm weather in February, in the region of Manhattan, Kansas, they emerge from hibernation, then go back into inactivity as the cold weather returns. As spring arrives, in the northern regions, the adults mate and lay their eggs during several weeks, in March, April or May, depending on the latitude and season.

The nymphs that hibernate over the winter contemporaneously become adults, mate and lay eggs some weeks later. It is our supposition, supported by observation and experimental breeding, that the adults, hibernating over a winter, produce a generation many individuals of which, in turn, give a second generation which pass the following winter as nymphs. The contemporaneously hibernating nymphs, maturing and laying eggs considerably later in the spring or early summer, give offspring which become adults in time for the coming winter—a sort of irregular alternation of hibernating generations, the one as adults, the other as nymphs, and a generation in the summer of every other year which does not go through the winter. Such availability of both adults and nymphs the year round may facilitate their survival through the severe meteorological and other hazards of environment.

Scheme of Alternation of Hibernating Generations of Northern (U.S.A.) Grouse Locusts (Tetriginae)

(From the author in Bibliographia Genetica V, 1929.)

Winter		Spring		Summer		Autumn		Winter
ADULTS	produce	NYMPHS	become	ADULTS	produce	NYMPHS	remain	NYMPHS
NYMPHS	become	ADULTS	produce	NYMPHS	become	ADULTS	remain	ADULTS

In southern Texas and Louisiana the species **T. parvipennis, P. texanus, A. eurycephalus, Telmatettix aztecus** and others are active the year round except at times when the temperature is below 50°-60° F. Thus they differ from the northern species and members of the same species (**T. parvipennis** and **Acrydium arenosum**) in that they do not spend so much inactive time each year. They undoubtedly produce more generations in the south than in the north, depending on the latitude. At Baton Rouge, La., males and females of **P. texanus** were completely inactive early on a frosty February morning when the temperature was below 50° F., but were actively feeding and copulating by 3:00 p.m. when the temperature had gone up above 70° F. in the shade.

There is the difference, however, between the southern Louisiana to Tampico, Mexico, species and those of Manhattan, Kans., and Chicago, Illinois, in that the southern grouse locusts do breed during the winter in the northern green houses, although not so well as in the spring and summer; whereas, the northern ones will not breed at all until late winter, and then much better after a period of hibernation in a cold environment. It has been possible to secure an extra winter generation of **A. arenosum** from Manhattan, Kansas, by means of artificial light. Both mercury vapor and ordinary white bulb light were employed and proved effective. This is a field which should be further exploited (Sabrosky, Larson, and Nabours, 1933).

Some northern (region of Chicago) species of **Tettigidea, Paratettix,** and **Acrydium** were first used in the experimental breeding (1906-1908). They gave only one or, at best, one and a half generations a year. They would not breed during the fall or winter, even in the warm greenhouse. It was, therefore, decided to secure some southern members of the sub-family which, it was thought, might find the environment of the greenhouse more like that to

which they had been accustomed in nature. In September, 1908, specimens of **Paratettix texanus** were collected in the region of Houston, Texas. They were bred in a greenhouse of the University of Chicago for an average of four succeeding generations a year. Although they slowed down in the winter, their activities did not wholly cease.

The stocks were removed to the Kans. Agric. Expt. Station, Manhattan, in 1910, where the experiments have since been in continuous progress. Additional specimens of this and other species have been collected at Many, La.; Beaumont, Houston, Sugarland, San Antonio, Austin, College Station, and Brownsville, Texas; Monterrey, Tampico and Vera Cruz, Mexico, on some 30 other expeditions during the ensuing 37 years.[3] Specimens of **Apotettix eurycephalus** for experimental breeding were first collected at the village of Tamos, near Tampico, Mexico, in August, 1911. Specimens of this and other species have been added from the various areas in Texas and Mexico during each of the subsequent collecting trips.

Apotettix eurycephalus, Paratettix texanus, Tettigidea parvipennis and **Telmatettix aztecus** from southern Texas and Mexico, with a few of the latter from Pasadena, California, have been bred in considerable or large numbers in the order given (See bibliography). **Acrydium arenosum,** from the region of Manhattan, Kansas, have been employed to a considerable extent, although they give only one, or at best, two, generations a year (Nabours, Larson and Hartwig, 1933; Sabrosky, Larson and Nabours, 1933).

Compared with the species of **Drosophila,** the breeding of the grouse locusts is most arduous. Two of the four generations a year of the southern species and varieties are grown during an optimum period, approximately March to June, inclusive; while the other two generations are drawn out over the long period of about eight months, from July to February. The mortality is high at all times but especially bad during the periods of their slow growth. All the stocks except **T. parvipennis** died in the summer of 1936, due probably to disease-causing fungi, although protozoa were also found. The disease was apparently progressively sponsored by the extreme darkening of the greenhouses to lessen the severity of the extended hot weather of the summers of 1934, 1935, and 1936.

The cages used consist of 9 x 15 inch Pyrex or other well annealed glass cylinders set in bulb pots, partly filled with sand at the bottom and loam as rich as possible with humus on top. A 3 or 4 inch pot, with the hole plugged, is placed upside down over the hole in the bulb pot before the sand and loam are put in. This inside pot supposedly provides for the aeration of the soil. The food, consisting of algae and decayed vegetable matter, is best placed on the projecting bottom of the inverted pot and allowed to run down over part of the soil. The cylinders have covers made of 20-24-mesh screen wire (Nabours, 1914, 1937; Needham, 1937).

A male and female are mated in a cage and the eggs are laid in the ground. Soon after hatching, the young are transferred by means of a suction

[3]Two of the more extensive exploratory and collecting excursions were provided for by grants-in-aid by the National Research Council (1933) and The American Academy of the Arts and Sciences (1937).

machine (Needham, 1937) to new cages where they remain until records of the color patterns are made. The color patterns are distinct from the beginning, but records can be made better during the 3rd or 4th instars. To wait longer entails considerable losses in records since the mortality is continuous and rather large. For mortality tables of **A. eurycephalus**, see Nabours, Kans. Tech. Bul. 17 (1925).

Individuals often live in the laboratory four to six months. The oldest recorded life-span was that of a female which lived a few days more than nine months. After the records are made all, except those reserved for further mating, are preserved in 95 percent alcohol. After a change of alcohol the vials are hermetically sealed with a torch. The mated individuals, after the eggs are deposited, are similarly preserved when they do not die prematurely and become decomposed. In this way, up to a recent counting, 416,795 specimens had been conserved in 46,833 vials. In addition, several thousand miscellaneous specimens from various areas, ranging from Manhattan, Kansas, to Vera Cruz, Mexico, have been preserved.

The alcohol constitutes a superb preservative. Specimens killed not too soon after an ecdysis exhibit the color patterns and other features excellently after 35 years. Robertson found that the tissues and even the chromosomes of specimens preserved for years were available for histology and gross cytology. This rather extensive and conveniently arranged collection of pedigreed specimens of several species of the **Tetriginae** is very useful for checking with the cytogenetic records. There are parents and offspring, both adult and nymphal, extending from those collected in nature for more than 100 generations in sequence. All of them are catalogued in relation to the more than 27,000 pages of original records.

In addition to the conserved bodies of the insects, as noted, there are more than 5,000 superb microscopic slides of testes, ovaries, fertilized and partheno-developing eggs and somatic tissues. Many of the slides are of tissues and the various stages of the germ cells bearing x-ray induced anomalies. A large number of the slides are from near to remote pedigreed progenies of males, some of the functioning chromosomes of whose sperms had been affected by irradiation. Each of the slides refers to the exact position in the records (Kans. Tech. Bul. 17, 1925 and forthcoming Bulletin) where the specimen belonged, and many of the bodies from which the tissues were taken are still available (For descriptions of reproductive systems and spermatogenesis, see Harman, 1920 and 1925). All of the slides were prepared by or under the direction of our late colleague, W.R.B. Robertson.

Pairs of **Tettigidea parvipennis** occupy hours and even days in copulation during the period of egg-laying which may last several weeks. The males and females of **Apotettix eurycephalus** are at the other extreme, since they rarely require more than five to ten minutes at a time for mating. Pairs of **Paratettix texanus** spend from 10 minutes to more than an hour at times in copulation. The following concerning courtship and mating has been summarized from the observations on **Tettigidea parvipennis, Acrydium granulatus** and **A. obscurus** by Hancock, 1902, and Nabours, 1929.

The male approaches the female with a hurried, tremulous or sometimes jerky gait, and climbs upon her from the side, at times facing temporarily in the reverse direction. The males occasionally climb up on each other but appear soon to realize their mistakes. At the sight of an individual of another species or what appears to be an uncongenial male, the female usually shakes her body in a way that apparently indicates aversion. In the genus **Acrydium**, there is no anatomical provision for the male to clasp the female, so that the pairs cannot go about in copulation for long periods as can pairs of the genus **Tettigidea.**

After establishing himself on the female, when **T. parvipennis** mate, the male extends his posterior abdomen down below that of the female and to one side, and turns up the end so that the subgenital plate is affixed by its anterior border to the process of the last sternum below her ovipositor. In the meantime the female usually offers some opposition and the male goes through a kind of convulsive orgasm. After copulation the ovipositor is made to open and close repeatedly as if to facilitate the entrance of the semen.

When ready to oviposit, the female selects a suitable spot on the medium muddy ground or vegetable mould (**Paratettix**) or among moss and lichens (**Acrydium** and **Tettigidea**). The abdomen is curved under and the four gonapophases are forced into the ground. They spread and close and the abdomen turns back and forth on the long axis and thus makes its way into the ground. During oviposition the front and middle pairs of legs are raised while the hind legs are drawn up to the sides, so that the abdomen extends into the ground to its maximum depth. However, there is considerable diversity in the positions assumed during egg laying; in some species, as **A. eurycephalus**, the female rests in almost normal standing position, the abdomen extending only slightly into the ground.

When first laid the pod of 15-20 eggs is white with a tinge of pink; they later turn to a more opaque, greenish, yellowish-white. Hancock ascertained that the diameter of the eggs of **Acrydium ornatus triangularis** is one-third the length of 1.75 mm., not counting the micropylar extension. The eggs of **A. eurycephalus** are approximately 2.1 mm. in length; those of **P. texanus** are slightly larger, while **T. parvipennis** have eggs that are still larger, the total length being about five times the diameter. The period of the egg stage, between oviposition and hatching, varies widely, the extremes noted ranging from 15-30 or more days.

According to Hancock (1902), polyandry is frequent among the **Tetriginae**, especially in the species of **Acrydium** (The Tettix of Hancock) and others that spend short and frequent intervals in copulation. Those that require longer periods at a time for mating, as the genus **Tettigidea**, are more likely to be restricted to the one male for each female. Polyandry has been frequently noted among **Paratettix texanus, Apotettix eurycephalus** and others during the 41 years of their experimental breeding.

A special experiment with **P. texanus** was carried out in 1923-24 by Caroline Perkins, E. H. Ingersoll and the author (Nabours, 1927). We found

that as many as seven males placed with one female, concurrently, during a period of 14 days shared respectively in the parentage of her 102 offspring. The last male or males copulating with a female tended to become the parents of the predominant proportion of her offspring. The sexual products of none of the males appeared to have any effect on the observable characteristics of the progeny of any other males of the polyandrous matings.

The chromosome number was first ascertained in **Choriphyllum** (one species), **Nomotettix** (one species), **Acrydium** (four species), **Paratettix** (two species) and **Tettigidea** (two species). In the 10 species of these five genera, both the prematurated germ as well as somatic cells contained the uniform number of 13 for the 2n-1 of the males and 14 for the 2n-2 of the females. One fundamental plan of structure appears to run through the entire subfamily. The chromosomes are so regular and dependable in size gradations in all these genera and species of the **Tetriginae** that it is possible to recognize every one of the series of six autosome pairs as well as the sex chromosomes. Pairs numbers 2, 3, 4 or 5, for instance, are found to have about the same size, shape and relations in any species of the various genera (Robertson, 1915; see also Harman, 1915, 1925; several papers by Robertson, and those jointly by Nabours, Stebbins and Robertson.)

Inheritance Experiments

The sub family **Tetriginae** have an extraordinary range and variety of color patterns, many of them conspicuously diagram-like. Most of the patterns are, as already stated, dominant to a mottled gray common to nearly all of the species. There are a few in **P. texanus** and **T. parvipennis** and one so far discovered in **A. eurycephalus** which are recessive to the common mottled gray "wild type" as well as to the series of dominants. Neither excessive temperatures, degrees of aridity, humidity, acidity and sunlight, irradiations, colors of soil, pots, foods, diseases, nor any other observable properties of the environment, however applied, have modified these color patterns to an appreciable extent, or in any way altered the color characteristics of the progenies. Such changes in the inheritance of the patterns and other aspects as occurred were referable to a few spontaneous mutations and certain fortuitous alterations of the chromosomes produced by means of drastic exposure to x-rays (See bibliography for papers and illustrations by Nabours, 1914, 1917, 1919, 1925, 1927, 1929; Bellamy, 1917).

From the inception of the cytogenetical studies of the grouse locusts in the University of Chicago, in 1906, and during the subsequent long period of experimentation in the Kansas Agricultural Experiment Station, the extraordinary, diagram-like dominant color patterns have been regarded as markers for the genes. It is regretted that more attention has not been given to such aspects as their taxonomy and ecology. They would make excellent material for such studies. Although many habitats have been explored, at least cursorily, and nearly a half million specimens conserved, the unexploited fields are still extensive, mostly swampy, teeming with mystery and problems and alluring to the real adventurer.

A project in genetics which employs such uneconomic organisms as the grouse locusts (**Tetriginae**) may be justified and supported by the director of the Agricultural Experiment Station for very good reasons. The principles and practices thus more economically derived and clearly defined are essential to a better understanding and application of the laws of heredity and the relations of the environment and other aspects of the biology which pertain to husbandry, sociology, medication and restoration. This is the plan of procedure in medicine and surgery wherein new agencies and methods are discovered and tried out thoroughly with planaria, other invertebrates, mice by the hundreds of thousands, great numbers of rats, guinea pigs and dogs. The principles and facts are thus tested under the most critically scientific circumstances before they are applied to healing and the treatment of the diseases of the useful domestic animals and man.

The following resumé of the principal results of the cytogenetic experiments with the grouse locusts and observations has been derived, as have most of the statements in this paper, from the publications of the author and colleagues, and the manuscript of an extended monograph by Nabours and Stebbins (1947). The numbers in parentheses refer to the paper listed in the Bibliography:

1. Classification, distribution and habits in nature (5-19).
2. Methods of experimental breeding (9, 18, 30).
3. Description of the characteristics: There are more than 100 all-over and diagram-like, generally dominant and few recessive, conspicuous color patterns, a lethal, the dimorphism of wing and pronotum lengths, and several teratogenic aspects (9, 13, 14, 16, 17, 18, 25, 26, and MS.).
4. Crossing over of genes occurs practically exclusively in the females of **A. eurycephalus** (15, 17), but in both males and females (though not equally in **P. texanus**) of other species (18, 25).
5. There is the extraordinary situation of close linkage of all 21 genes for color patterns and the lethal on one pair, the smallest, of the autosomes in **A. eurycephalus** (17, 18, 24). In **P. texanus**, 24 of some 26-30 conspicuous, dominant color patterns have their genes so closely linked on the one (as yet unidentified) pair of autosomes that only two have exhibited crossing over during extensive breeding (14, 18). In **A. arenosum** and **T. parvipennis**, the genes for the color patterns are more widely distributed among the pairs of autosomes; and crossing over occurs in the gametogenesis of both males and females (3, 25). No sex-linked characteristics have been discovered except the one x-ray induced, noted in item 10-15 (29). Summaries of the crossing over data, with revised and extended maps of the genes which condition the color patterns, the lethal and the x-ray translocated genes in **A. eurycephalus** are available (17, MS.).
6. A lethal gene in **A. eurycephalus** by some as yet unknown means abruptly killed those individuals homozygous for it at the stage some 3-4 days before time for hatching. The single dose of the lethal

made the heterozygotes significantly more viable and perhaps more vigorous than the sibs homozygous for the normal allele. It appears that the death-dealing gene in double or homozygous quantity and potency provided for some sort of deleterious activation or retardation which caused death before time for hatching; whereas, the amount and efficacy of the single or heterozygous gene functioned favorably to vigor and viability beyond that available for the normal sibs (26, MS).

This phenomenon is not without parallel in other organisms Gustafsson (1946) has presented a comprehensive review of the work of several authors. He concludes "that mutations lethal in homozygous condition may increase viability when they occur in the single dose (and) vigor may also be affected in a general sense." It is suggested (Nabours and Stebbins in Manuscript) in this connection, that there is nothing inherent in lethals, per se, that provides for an occasional one to function in the heterozygous amount and potency discretely favorable to vigor and viability. In contrast, certain lethals, such as 'creeper' in fowls, are distinctly deleterious in the heterozygous quantity and consequence. No one lethal, as among genes in general, is probably exactly like any other with respect to its effects either in the n or 2n amount. There are, perhaps, many kinds and degrees of potency ranging from the favorable one in **A. eurycephalus** and those in plants, cited by Gustafsson, to 'creeper' in fowls and others that barely allow the heterozygous bearers to propagate and survive (4, 26, MS.). Comparable examples of the more or less effects of other single or double genes are proposed (Nabours and Stebbins, MSS.).

7. Many of the females of **P. texanus, A. eurycephalus, Telmatettix aztecus** and other species were partheno-reproductive. The unfertilized eggs, with rare exceptions, hatched into females. Segregation and crossing over of the genes occurred in the gametogenesis of partheno-reproduction to the same extent as when the eggs were fertilized (Nabours, 1919, 1925, 1929). Such partheno-produced individuals were, with possibly a few exceptions, homozygous for all the recognizable genes they carried.
8. Females were partheno-reproductive and then, upon mating, gave additional progeny of both sexes which exhibited the characteristics of the male parent as well. The mated females could have part of their ova fertilized and also produce from unfertilized eggs additional offspring, as in straight parthenogenesis. The females were rarely partheno-reproductive after having mated and given offspring from fertilized eggs. It appeared that when mated to adequately potent males the females did not oviposit unfertilized eggs.
9. The members of the homologous pairs of chromosomes of the partheno-developing eggs lie close together, respectively, in early divisions and not far apart, each from the other, in later cell-generations in

such gonomeric position as to suggest that the second polocyte division had not been completed (Robertson, 1930).

10. A portion of an autosome bearing the closely linked genes for the dominant OTG color complex in **A. eurycephalus** was translocated under the X-raying (approximately 6000 r) of a male and attached to another pair.[4] In the cytological preparations one member of the smallest pair of autosomes (Robertson's Number 1) was found to be conspicuously shorter, and one of the middle-sized pair (Number 4) correspondingly distinctly longer, than their respective normal homologs.
11. The unbalance (deficiency in the first or smallest, and accretion on the fourth autosomes) in chromatin and perhaps the rearrangements of genes, thus fortuitously induced, profoundly influenced the viability and morphology of the post-hatched zygotes. The normal numbers of eggs hatched, but the chromosomal aberrancies and respective combinations were responsible for consistent viability results which ranged proportionately and consistently from 99+ percent lethal to 98+ percent viable up to the 3-4 instars when they were recorded (24, 27, 28, 29, MS). The effects on the bodies were from slight to monstrous morphological impairment, difficulties in moulting, feeding and other teratogenic aspects (Nabours, 1937, Plate II).
12. These cytogenetic operations and observations thus revealed for the first time, in this species, the particular pair of autosomes, Number 1, the smallest, as the bearer of all 19 of the closely linked genes for the conspicuous dominant, and the one point recessive, color patterns, and the lethal. There was also the disclosure that it was to one of the middle-sized, the fourth pair, that the OTG section of the number 1 autosome had been translocated (24, 29, MS).
13. Another x-raying[5] in this species translocated a portion of the Number 1 autosome bearing the gene for dominant stripes along the femora of the jumping legs (the pattern designated by W). The attachment, this time, was made to the X, sex chromosome. The genetic evidence, as usual, came first and was unmistakable (e.g. mating 6673 in MS.). It was then ascertained by cytological examination that the sex chromosome had been appreciably augmented by the autosomal chromatin and the point of the connection was quite apparent (Nabours, Stebbins and Robertson, 1941). This newly accreted sex chromosome was found to be also the bearer of an extra, perhaps the autosomal, centromere, and without having lost its own. The donor, Number 1 autosome of this translocation, was lost, possibly due to the transfer of its indispensable centromere to the accreted X, sex chromosome which survived for the experimental breeding. This translocation thereby established a conspicuous, dominant, **sex-linked**

[4]With grants-in-aid from the Dept. of Genetics, Carnegie Institution and the Henry Fund of the National Academy of Science.
[5]Professors J. O. Hamilton and Leo Hudiburg of the Physics Dept., Kansas State College, rendered invaluable service in the application of the x-rays.

color pattern characteristic, the only one recorded in any species of the subfamily **Tetriginae** or, so far as we have been able to ascertain, in any species of the Orthoptera (29, MS.).

14. The donor 1st, and receptor 4th, autosomes of the first (1930-33) translocation and the receptor X, sex chromosome of the second (1933-41) x-ray induced anomaly with its extra centromere were subjected to further cytogenic experimentation separately and together. The variability in the post-hatched viability due to chromosomal deficiency, augmentation, genic displacements, extra centromere and, perhaps, other aspects of anomaly ranged consistently again from almost completely lethal to nearly normal (24, 29, MS.).
15. The altered position and location of the translocated genes appeared to make no difference in the phenotypic manifestation of the diagram-like, dominant color patterns. The OTG pattern complex was the same whether the genes were attached to the fourth or remained in the original position on the first autosome. Likewise, the yellow-brown stripe (W) along the femora of the jumping legs was not altered phenotypically by the translocation of its gene complex over and into the environment of the X, sex chromosome (29, MS.).
16. There was an obvious absence of dominance and recessiveness of most of the color patterns with respect to each other. The large majority of the patterns could be regarded as dominant to the mottled gray of the so-called wild type which was the most numerous in nature. In relation to each other these dominants over the wild type exhibited striking degrees of phenotypic blending, or some of them could have been regarded as producing mosaics of kinds (9, 13, 14, 16, 18, 21, 22, MS.).
17. There are descriptions of results, and consideration of the mooted subject of the inheritance and influence of the environment as they pertain to teratogenic features such as upturned, downturned, twisted and stubby pronota, frayed and otherwise unusual wings, abnormal abdomen and other malformed structures (2, MS.).
18. The dimorphism of long and short wings and pronota, with occasional intermediates, in **A. eurycephalus, P. texanus** and others, appears to be conditioned partly, at least, by the elements of the seasons (3, 18, 21).
19. This genetic-environmental conditioning of the wings and pronota in **A. eurycephalus, Paratettix texanus** Hancock and some other species that we have tested is in striking contrast with that in the species **Tettigidea parvipennis** Harris. In the latter the similar dimorphism in the lengths of the pronota and wings constitutes a distinct Mendelian pair of characteristics with short dominant and long recessive. Neither the elements of the seasons nor any other aspects of environment appear to alter this striking and strictly genetically controlled procedure (Nabours and MacQueen, 1937 abstract; Good, 1941).

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AN UNDESCRIBED EVERSIBLE GLAND IN THE LARVAE OF CHLAENIUS (Coleoptera Carabidae)

WM. P. HAYES, *University of Illinois*
and
H. F. CHU, *Institute of Zoology,*
*National Academy of Peiping, China**

The larvae of only a few families of Coleoptera are known to possess integumental glands. Most of those that are known are noneversible glands located beneath the integument and show externally only as an opening on the surface. Several species of Centharidae and Chrysomelidae (including the new separate family Donaciidae) have scattered glands over the body. In an examination of the 124 plates in Böving and Craighead's "An Illustrated Synopsis of the Principal Larval Forms of the Order of Coleoptera" (1931) glands are shown in the larvae of the Cantharidae and Chrysomelidae and in **Hyperasis signata** Oliv. of the Coccinellidae. In **Hyperasis** these authors call the gland opening the "foramen of Peyerimhoff." The only eversible organs shown by Böving and Craighead (Plate 67, fig. I) are found on the second thoracic and eighth abdominal segments of the larva of **Ptilodactyla serricollis** Say. These they call "retractile diverticula." There is no indication that these structures are glandular.

Packard (1895. p. 115) states that "Claus has shown that the larva of **Lina populi** and other Chrysomelidae possess numerous minute eversible glands in each of the warts on the upper surface of the body, each gland containing a whitish repellent fluid smelling like the oil of bitter almonds and containing salicylic acid derived from its food plant, which issues as pearl-like drops. Cándezè thinks the fluid may contain prussic acid. The fluid is secreted by a variable number of glandular cells, each provided with an efferent duct."

A single pair of apparently undescribed eversible glands has been found by the writers in the larvae of the carabid genus **Chlaenius.** These superficially resemble the glands figured by Böving and Craighead in **Ptilodactyla** except that there is only a single unbranched gland located laterally on each epimeron of the metathorax (fig. 3, GL) with none occurring on the abdominal segments. These have been found in preserved larvae of two species, **Chlaenius prasinus Dejean** and **C. sericeus** Forster. The specimens had been preserved in 70% alcohol and the microtome sections, described later, were made from them without benefit of better fixatives. In most of the preserved specimens, the glands were found to be protruded. These larvae are reported to live under the soil near water.

External Appearance: The metaepimera (fig. 2 and 3, EM) of these larvae are located dorso-caudad of the coxal articulation. The epimeral sclerite is irregularly quadrate with its longitudinal axis about three times as long as the dorso-ventral axis. Near the center of the epimeron is the

*Contribution No. 266 from the Entomological Laboratories of the University of Illinois, Urbana.

gland opening (fig. 2, OP) which is surrounded by a semi-lunar sclerite or peritreme[1] (figs. 2 and 3, SC) that resembles somewhat the peritreme of a spiracle. The sclerite in **C. prasinus** is somewhat larger and more irregular in outline than that of **C. sericeus.** **The gland of C. prasinus** (fig. 2) is shown in a retracted position while the protruded position of **C. sericeus** is shown in figure 3 (GL). An enlarged drawing of this protruded gland of **C. sericeus** is shown in figure 8 where it will be noted that the external surface is partially covered with small wart-like tubercles (TU). A similarly everted condition of the gland in **C. prasinus** (fig. 6, TU) also shows that only a part of the surface is covered with tubercles and these tubercles are considerably smaller than in **C. sericeus.** When protruded the base of these glands is seen to be surrounded by the ring-like sclerite (SC).

Near the distal end of the everted glands in preserved specimens, there can be seen through the cuticula, under high magnification, a cluster of cells that constitute the gland cells. These are quite different in the two species. In **C. prasinus** these cells (fig. 6, GC) are arranged in a narrow triangle, while in **C. sericeus** (fig. 8, GC) they are grouped in narrow strands which coalesce at the distal end of the gland. These secretory cells seem to have no ductuoles leading to the exterior and it seems probable that the secretions must be released by osmosis through the cuticula. These gland cells will be considered histologically below.

The Inverted Gland: A gland of **C. prasinus** in the normally retracted position in shown in figure 1. This drawing was made from a dissected gland and shows the outer or external appearance of the structure. The tubercles (TU) show through the body wall and are located on the inner aspect. The external sclerite (SC) and the opening of the gland (OP) are similar to the same structures shown in figure 2. On the inner or ental end of the gland there are several triangularly pointed processes (GC) which probably represent the gland cells in their normally retracted position. These show as a triangular structure in figure 6 (GC). These processes should be compared with those of a similar nature in **C. sericeus** (fig. 7, GC).

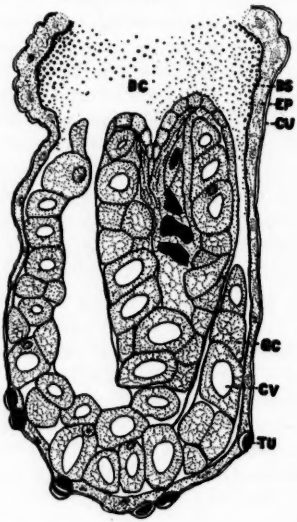
A semi-diagrammatic sagittal section of the retracted gland of **C. sericeus** is shown in figure 7. Here it will be noted that the cuticle (CU) lining the inner aspect shows the same tubercles (TU) that are noted on the outer aspect when the gland is extruded. Underneath the cuticle is a single layer of epithelial cells (EP) and the basement membrane (BS). A single layer of larger cells each with a large cavity or vacuole adjoins the basement membrane beginning at about one-half the depth of the gland reservoir (RS) and at the bottom of the reservoir become elongated into strings of cells. These (GC) cells are the finger-like processes seen through the cuticule and are represented by dotted lines in the drawing of the everted gland (fig. 8).

Histology: Microtome sections of the glands found in the two species

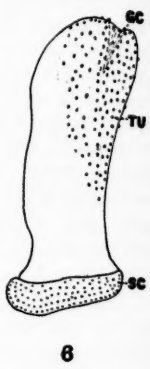
[1]Entomologically the term peritreme is usually thought of as a sclerite surrounding a spiracle but Torre-Bueno in his "A Glossary of Entomology" (1937) and others point out that a peritreme can be a sclerite surrounding any opening in the body. Gr. **peri.** around + **trema** hole.

SC
SP
TU
GC

1


BC
BS
EP
CU
GC
CV
TU

4


GC
TU
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6

SP
SC
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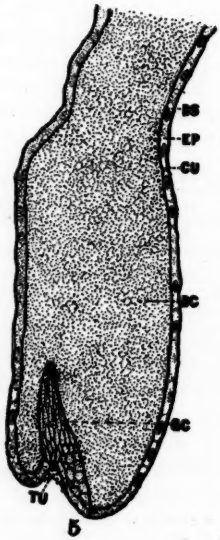
2

BS
EP
CU
TU
RS
GC
GC

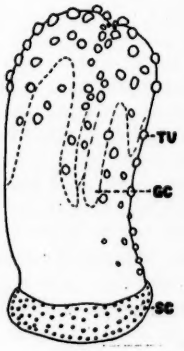
7

GL
SC
EM

3


BS
EP
CU
GC
GC
TU

5


TU
GC
SC

8

show them to be quite different. They were sectioned in the everted position. It is evident in both species, that they contain, when everted, a larger number of blood cells (figs. 4 and 5 BC). So that it seems safe to say that they are everted by blood pressure. No closely associated muscles were noted in either species. The structure of **C. prasinus** seems to be the more simplified. The gland cells are clustered into a triangular mass near the distal end. The cells are smaller than in **C. sericeus** and do not show the large central vacuole. Very little detail could be made out in these cells. On the other hand, in **C. sericeus** (fig. 4) the gland cells, which in figure 7 showed as string-like masses, become massed in the distal end of the gland. The cells are large and contain large cavities or vacuoles (CV) and nuclei are found crowded out toward the edge of the cells. In these cells no ductuoles leading to the outside of the cells were noted and there seems to be no direct means for the secretions to get to the outside of the cell except by osmosis. Apparently the secretions of the cells accumulate in the reservoir (fig. 7, RS) when the gland is retracted and are evaporated from the surface of the gland when everted. The assumption is made that these are odiferous glands (as are osmetaria in the Lepidoptera) with a repellent function.

The glands of **C. prasinus** are considerably larger when everted than in **C. sericeus** in comparable sized larvae. In **C. prasinus** the length is 0.8 mm. and the width 0.32, thus being about four times as long as broad. The length of **C. sericeus** is 0.4 mm. and its width is 0.14 mm. Thus it is noted that the length of the gland in **C. prasinus** is about twice as long as in **C. sericeus.**

The writers are indebted to Yu-Su Liu (Mrs. H. F. Chu) for her invaluable help in the preparation of microtome sections of these glands. Her knowledge of histological technique has made it possible to prepare slides for study from specimens that were poorly preserved for such a study.

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EXPLANATION OF FIGURES IN PLATE.

Fig. 1. **Chlaenius prasinus,** a gland in normal retracted position.
Fig. 2. **Chlaenius prasinus,** lateral aspect of metathorax showing the opening of the gland.
Fig. 3. **Chlaenius sericeus,** lateral aspect of metathorax showing the protruded gland.
Fig. 4. A sagittal section of a protruded gland of **Chlaenius sericeus.**
Fig. 5. A sagittal section of a protruded gland of **Chlaenius prasinus.**
Fig. 6. **Chlaenius prasinus,** a gland in protruded condition.
Fig. 7. **Chlaenius sericeus,** a semi-diagrammatic drawing showing the sagittal section of the gland in normal retracted position.
Fig. 8. **Chlaenius sericeus,** a gland in a protruded condition.

EXPLANATION OF ABBREVIATIONS

BC Blood cell
BS Basement membrane
CU Cuticle
CV Cavity of gland cell
EM Epimeron
EP Epithelium
GC Gland
OP Opening of gland
RS Reservoir
SC Sclerite of gland
TU Tubercle

NOTES AND DESCRIPTIONS OF DORILAIDAE (Pipunculidae-Diptera)

D. ELMO HARDY*

Since the writer's revision of the Nearctic Dorilaidae was published, the following synonymy and homonymy has been noted:

Pipunculus hertzogi Rapp, 1943, Ento. News, 54: 118. This is a synonym of **Dorilas ater** (Meigen). Synonymy confirmed by Mr. E. T. Cresson who studied the type in the Philadelphia Academy of Science collection.

Pipunculus nudus Rapp, 1943, Ento. News, 54:223-224. Synonym of **Tömösváryella coquilletti** (Kertesz). Synonymy confirmed by Mr. E. T. Cresson who studied the type. The writer studied three specimens which Mr. Rapp said were paratypes, although they were not labeled as such. A male from the type locality was **T. coquilletti** (Kert.). Two females from Montreal cannot be determined without being associated with the males; they belonged to two different species neither appearing to fit with the type. The above mentioned specimens may possibly have been considered metatypic by Rapp. Even though he called them paratypes he failed to list them in his paper.

Pipunculus nudus var. **tangomus** Rapp, 1943, Ento. News, 54:224. Synonym of **Tömösváryella sylvatica** (Meigen). Mr. Cresson studied the type and confirmed this synonymy. The writer studied two paratypes, which had not been labeled. One male from the type locality was a specimen of **Dorilas caudatus** var. **discolor** (Banks). The other male from La Trappe, Quebec, belonged to **Tömösváryella similis** (Hough). The writer fails to see how three very distinct species belonging to two well-defined genera can "conform structurally." Besides being a synonym, the name **P. nudus** Rapp is preoccupied by **nudus Kertesz**, 1912, Ann. Mus. Nat. Hung., 10:294.

Allomethus oleous Rapp, 1943, Ento. News, 54:223. This appears to be a synonym of **Dorilas aequus** var. **argryofrons** (Hardy-Knowlton). Mr. Cresson reported by correspondence "Of this species we have two females, one labeled type, the other allotype. What became of the two males (one which should be the type) I do not know." He further indicated that the specimens fit in the genus **Dorilas** and run out in the writer's key with **atlanticus** (Hough) and **aequus** (Cresson). The antennae are broken from the specimens and Mr. Cresson was not able to place the species further.

Dorilas dudai n. n.

New name for **Dorylas**[1] **curvitibia** Duda, 1940, Folia Zoologica et Hydrobiol., 10:218. Preoccupied by **Dorilas femoratus curvitibiae** Hardy, 1939, Journ. Kans. Ento. Soc., 12:19-20.

Dorilas electus n.n.

New name for **Dorylas caudatus** Duda, 1940, Folia Zoologica et Hydrobiol., 10:217. **Nec. D. caudatus** (Cresson), 1911, Trans. Amer. Ento. Soc., 36-289.

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*Assistant State Entomologist, Ames, Iowa.
[1]Kertesz' amended spelling of **Dorilas.**

Dorilas peruensis n.n.

New name for **D. umbrinus** (Becker) 1900, Berl, Ento. Zeits., 45:245. **Nec D. umbrinus** (Loew), 1857, Ofvers. K. Vet. Akad. Forh., 14:374.

Becker described what he thought was the female of **umbrinus** from Peru. The writer has studied the female of Loew's species from Africa and found it to be very distinct from that which Becker described from South America. Becker's specimen in the Berlin Zoological Museum will be set up as the type of **D. peruensis.**

Dorylomorpha rufipes aczeli n.n.

New name for **Tömösváryella (Dorylomorpha) rufipes minima** Aczel, 1939, Zool. Anz., 125:65. Preoccupied by **Tömösváryella minima** (Becker), 1897, Berl. Ento. Zeits., 42:85.

Tömösváryella aliena n.n.

New name for **T. propinqua** Hardy, 1943, Kans. Univ. Sci. Bull., 29:169-171. Preoccupied by **T. propinqua** (Becker), 1913, Ann. du Mus. Zool. de L'Acad. Imp. Sci. St. Petersb., 17:607.

Becker's **Dorylas propinquus** is obviously a **Tömösváryella.** He states that it belongs "aus der gruppe mit fehlendem Randmal" and is related to **littoralis** Becker.

Dorilas (Dorilas) apicarinus (Hardy-Knowlton)
New Combination

(Figs. 1a-b)

Pipunculus femoratus[2] var. **apicarinus** Hardy-Knowlton, 1939, Ann. Ento. Soc. Amer., 32:114-115.

The discovery of a female specimen which apparently belongs to **D. apicarinus** (Hdy-Kn) indicates that this is a distinct species and should be separated from **houghii** (Kertesz).

The species is distinguished from **D. houghii** by its dark brown to black third antennal segment, the longer third costal section of the wing, the more sinuate ultimate section of the fourth vein, and the marked difference in the genitalia of both sexes. The male has a rather small apical membranous area which does not extend down the dorsum as in **houghii** and the apical keel is well developed (cf. figs. 43D and 44B, Hardy, 1943, Univ. Kan. Sci. Bull., 29:209). The female genitalia are characterized by the presence of a pair of tubercles on the underside of the ovipositor. Following is the first description of a female of this species:

Female. Head: Front, face and occiput silvery gray pubescent, only the ocellar triangle shining black. Antennae dark brown, third segment very finely pubescent and short acuminate in shape (fig. 1a). **Thorax:** Mesonotum brownish gray pollinose, pleurae gray. Anterior portion and lateral margins of metanotum rather conspicuously covered with pale pile, very fine yellow dorsocentral hairs present. Scutellum with a few short yellow

[2]**P. femoratus** Cresson is a synonym of **P. houghii** Kertesz.

hairs on the hind margin. Propleurae each with a well developed fan of long yellow hairs. Humeri and halteres yellow, tegulae brown. **Legs:** Yellow, except for the brownish coxae. The femora are very faintly discolored medianly. **Wings:** As in the male. **Abdomen:** Very slightly clavate from dorsal view, widest at about segments four to five. The first two terga are densely gray pollinose and the first has no strong lateral hairs. Terga three to five are polished black on the dorsum, gray on the sides and on hind margin except for a narrow median portion. Sixth tergum polished black except for gray sides, hind margin of sixth not excised. Abdomen rather conspicuously covered with short yellow pile. Base of ovipositor polished reddish brown, subelongate in shape and with a pair of well developed tubercles below. Piercer yellow and straight, reaching just slightly beyond the apex of the second abdominal segment (fig. 1b).

Length: Body, 3.6 mm; wings, 5.0 mm.

The above described female was from Salt Lake City, Utah, September 3, 1941 (F. C. Harmston).

Dorilas (Eudorylas) bilobus n. sp.

(Figs. 2a-d)

The species is related to **D. aequus** (Cresson) and is distinguished by the unusual development of the male hypopygium. It runs out with **aequus** in couplet 37 of the writer's key to the genus **Dorilas**[3]. It separates by having the eighth abdominal segment entirely reddish to yellow, two times as long as the fifth abdominal segment and over one-half as long as the remainder of the abdomen from lateral view; also in being pointed at the apex as seen from dorsal and lateral views (figs. 2a, 2d). The eighth segment of **aequus** is black, is slightly shorter than the fifth segment and rather quadrate in outline. From a lateral view the eighth segment is scarcely one-fifth as long as the remainder of the abdomen. The harpagones are also very different in both species.

Male. Head: Face and front densely silvery pubescent, occiput entirely cinereous. Junction of the eyes equal to the length of the frontal triangle. First two antennal segments yellow brown, second segment with very short inconspicuous bristles above and below. Third segment yellow, long acuminate at apex (fig. 2c). Bases of aristae yellow. **Thorax:** Opaque grayish-brown pollinose on the dorsum, gray on the sides. Mesonotum and scutellum almost devoid of pile. Propleurae bare. Humeri, tegulae and halteres yellow. **Legs:** Almost entirely yellow, coxae and last tarsal subsegments brownish yellow, hind femora very faintly brownish in the middle. All femora moderately slender, flexor spines weak. Hind tibiae somewhat swollen medianly and slightly arcuate, with no strong bristles on the outside median surface. **Wings:** Hyaline, stigma light brown and filling all of the third costal section. The third section is just slightly longer than the fourth and the two sections combined are one and one-half times longer than the fifth. The r-m crossvein is at the basal one-third of the discal cell and the ultimate section

[3]1943, Univ. Kans. Sci. Bull., 29:58.

of the fourth vein (M_{1+2}) is very slightly curved. **Abdomen:** Entirely opaque, almost devoid of pile. The first tergum is gray and has three short black bristles on each side. The other terga are brown pollinose on the dorsum, gray on the sides and posterior margins, except for a narrow median interruption. The venter is entirely yellow. The abdomen is very slightly clavate in shape, being widest at segments four to five. The fifth is rather strongly developed on the right side. The sixth and seventh terga are well developed, and visible from a dorsal view. These sclerites are lateral in position and do not extend around the venter beneath the genitalia. **Hypopygium:** Very strongly developed. Two times longer than the fifth abdominal segment from dorsal view (Fig. 2d). The entire genitalia are equal in length to the remainder of the abdomen from segments one to five and the eighth segment alone is over half the combined length of the remaining segments from a lateral view. The hypopygium has an elongate membranous area just to the left of the apex and this possesses a small unsclerotized development in the middle (Fig. 2a). From dorsal view, a basal cleft is visible on the right side and the segment is pointed apically (Fig. 2d). The harpagones fold down and lie beneath the fifth sternum in their normal position and are not visible unless pulled out. Both harpagones are bilobed and have a long slender lateral lobe at bases which curve down into the genital cavity. The outer harpago is developed into an elongate slender projection at apex. The inner is obtuse, rounded at the apex (fig. 2b). Harpagones conspicuously yellow pilose.

Length: Body, 4.5 mm; wings, 5.3 mm. Female unknown.

Holotype male: Cold Spring Harbor, Long Island, New York, May 30, 1931 (C. H. Curran). Type returned to the American Museum.

Dorilas (Eudorylas) dives n. sp.

(Figs. 3a-c)

This species appears most closely related to **D. varius** (Cresson) but actually belongs in a different subfamily because of the bare propleurae. It runs out with **varius** in couplet 17 of the writer's key to the **genus.**[4] It is distinguished by the lack of bristles on the propleurae; the elongate third costal section of the wing; the very short petiole of the cubital cell; having the r-m crossvein situated near the basal third of the discal cell and the first abdominal tergum without strong hairs or bristles on the sides. The genitalia are also distinctive.

Male. Head: Eyes joined for distance equal to slightly greater than the length of the front, this junction extends to within two or three facets of the median ocellus. The front is brown to black in ground color, rather lightly covered with gray pubescence. The median portion of the front is raised into a longitudinal ridge, this is polished black at about the lower one-third of the front. Face shining black in ground color and gray pubescent. Occiput gray below and slightly subshining brownish pollinose above.

[4]1943, Univ. Kans. Sci. Bull., 29:57.

Antennae brown, third segment acute at apex (fig. 3a). **Thorax**: Subshining black in ground color, gray on pleurae and metanotum, lightly brownish pollinose on the mesonotum and scutellum. A few very short, inconspicuous dorsocentral and scutellar hairs are present. Humeri and tegulae black, halteres yellow brown. **Legs**: Chiefly black. apices of femora, most of tibiae and tarsi yellow. All tibiae discolored with brown to black medianly. Femora slender, flexor spines very weak. **Wings**: Faintly fumose, stigma yellow brown and filling all of the third costal section. Third section three times longer than the fourth. The two combined are about equal in length to the fifth section. The r-m crossvein is at the basal one-third of the discal cell and the ultimate section of the fourth vein is just slightly curved. The petiole of the cubital cell is less than one-half as long as the m-cu crossvein. **Abdomen**: Polished black except for opaque grayish brown first tergum, opaque brown anterior three-fourth of the second tergum and for an opaque brown median spot on anterior edge of third tergum. Sides parallel or nearly so. Pile rather conspicuous but very sparse. First tergum with no well-developed comb of hairs or bristles on the sides. Sixth and seventh terga not visible from a dorsal view, these plates are ventral in position and poorly developed. **Hypopygium**: Large and well-developed, about equal to the fifth segment in length and strongly compressed to the right (Fig. 3c). A large subapical membranous area is on the venter of the eighth segment on the left side, this membranous area is not visible from a dorsal view and possesses a small raised portion in the middle above. The hypopygium is conspicuously haired. The harpagones are very short, broad and rounded at their apices, they are scarcely two times as long as wide (Fig. 3b).

Length: Body, 3.0 mm.; wings, 3.5 mm.

Female unknown.

Holotype male: Vic. Indianapolis, Indiana, July 16, 1944 (F.C. Harmston). One paratype male same locality and collector July 9, 1944.

Type returned to the Utah State Agricultural College, paratype retained in the Iowa State College Collection.

Dorilas (Eudorylas) tarsalis (Banks)

(Fig. 4a)

Pipunculus tarsalis Banks, 1911, Trans. Amer. Ento. Soc., 36:309-310.

This is the first description of the female of this species. It is related to **montivagus** Hardy and runs out with that species in couplet 89 of the writer's key to the **Dorilas**. It is distinguished by the longer stigma which fills over half of the third costal section; the fifth costal section not longer than the third and fourth combined; the ultimate section of the fourth vein gently curved; more of front polished black and the pircer of ovipositor very slender, abruptly terminating its small subglobose base (Fig. 4a).

The female differs from the male as follows: The front is as wide as the face and is very slightly expanded just above the median portion. Upper three-fourths of the front polished black. Lower portion gray pubescent, the

polished portion extends into the gray as a narrow median line ending the length of three eye facets above the antennae. The sixth abdominal tergum is subshining, very lightly pollinose, its posterior margin is not excised. The ovipositor base is black in ground color and finely gray pubescent. The base is nearly as wide as long and has a small swelling on the posterior portion below. The piercer is slender, straight and reddish yellow in color, it is separated from its base by a distinct suture. The piercer is slightly longer than its base (fig. 4a) and extends to about the apex of the third abdominal segment.

Length: Body 3.0 mm.; wings, 3.4 mm.

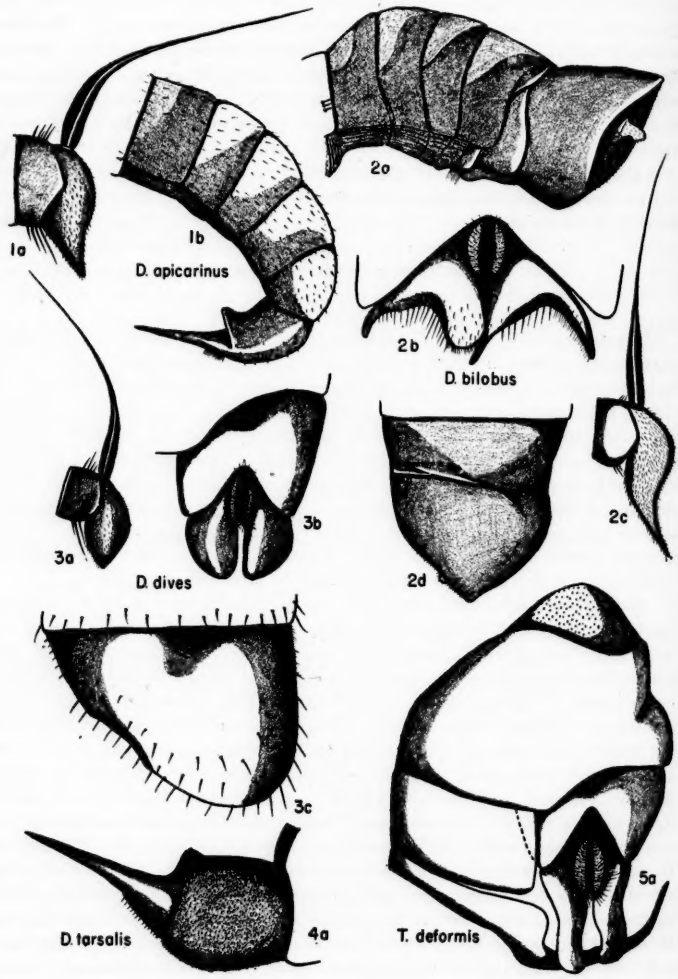
The above described female was from Missaukee Co., Michigan, July 8, 1945 (R. R. Dreisbach).

Tömösváryella deformis n. sp.

(Fig. 5a)

This species is related to **T. contorta** Hardy and runs out with that species in couplet 1 of the writer's key to the genus. It is distinguished by having the male hypopygium almost bare, not densely pilose as in **contorta.** The dorsal cleft of the hypopygium is more to the left side instead of being in the middle. The ninth sclerite is cleft nearly to its base, and cleft on its hind margin extends about four-fifths its length on a middle line instead of about half its length as in **contorta.** The harpagones are thicker and shorter, more rounded at their apices and about equal in length to the seventh abdominal sclerite (fig. 5a). The harpagones of **contorta** are slender, elongate, pointed at inner apices and one-third longer than the seventh sclerite. **T. deformis** is also more subshining not so gray pollinose as is **contorta.**

Male. Head: Junction of the eyes about equal to the length of eight eye facets. Upper portion of front and ocellar triangle shining black, frontal triangle and face silvery pubescent. Front with a longitudinal indented area extending to just above antennae. Third antennal segment moderately acuminate, brown in ground color, and densely white pubescent. Occiput subshining to polished black on upper third, cinereous below. **Thorax:** Subshining black in ground color, brownish pollinose on the dorsum, gray on the sides. A few very small, inconspicuous dorsocentral and scutellar hairs are present. Humeri and halteres yellow, tegulae black. **Legs:** Chiefly black, tarsi, narrow apices of femora and tibiae and bases of tibiae yellow. Hind trochanters each with a well-developed tubercle beneath. Hind femora and tibiae strongly bent and swollen on apical halves. Hind tarsi markedly flattened and broad. **Wings:** The third section of the costa is one-half as long as the fourth and the fifth section is one and one-half times longer than the third and fourth combined. The r-m crossvein is at the middle of the discal cell and the last section of the fourth vein is straight. **Abdomen:** Rather sparsely haired, chiefly subshining brownish black, lightly grayish on the first tergum and on the sides. First tergum with a comb of long hairs on each side. **Hypopygium:** In addition to the above given genital characters the eighth segment terminates in a large apical membranous area (Fig. 5a). The


1a
1b
D. apicarinus
2a
2b
D. bilobus
2c
2d
3a
D. dives
3b
3c
D. tarsalis
4a
T. deformis
5a

sixth segment is greatly attenuated on the venter and extends beneath the harpagones.

Length: Body, 3.0 mm.; wings, 3.3 mm.

Female: A specimen at hand apparently belongs with the male, although the hind legs are not so noticeably curved as in the female of **contorta.** The front is broad, distinctly wider than the face and shining black on the upper one-third. Hind trochanters white pubescent beneath, without tubercles. Hind femora and tarsi not greatly enlarged and curved as in the male and hind tarsi not so strongly flattened and broad. The abdomen is sparsely pilose and the sixth tergum is not excised on its hind margin. The base of the ovipositor is globose and small, black in color. The piercer is slender, straight and yellow. It is about one and one-half times longer than its base and extends just beyond the apex of the third abdominal segment.

Length: Body and wings, 3.0 mm.

Holotype male: Crestview, Florida, Oct. 15-16, 1914. Allotype female, data as for type. Both returned to the American Museum of Natural History.

EXPLANATION OF PLATE

Fig. 1. **Dorilas apicarinus** (Hardy-Knowlton).
(a) Antenna of female.
(b) Female abdomen, lateral view.

Fig. 2. **D. bilobus n. sp.**
(a) Male abdomen, left side.
(b) Male harpagones.
(c) Antenna.
(d) Male hypopygium, dorsal.

Fig. 3. **D. dives n. sp.**
(a) Antenna.
(b) Male hypopygium, ventral.
(c) Male hypopygium, dorsal.

Fig. 4. **D. tarsalis** (Banks).
(a) Female ovipositor, lateral.

Fig. 5. **Tomosvaryella deformis** n. sp.
(a) Male hypopygium, ventral.

A NEW SPECIES OF CYMATIA FROM AUSTRALIA (Hemiptera, Corixidae)

H. B. HUNGERFORD*

While checking corixid material in the Snow Collections in an attempt to make a generic key to the Corixidae of the world, we discovered a new species of the genus **Cymatia** Flor in some material taken by R. G. Wind on the Prince of Wales Island, Australia. This is the first record of any of the **Cymatia** group from Australia. The key following the description will separate this new species from the rest of the genus.

Cymatia nigra n. sp.

Size: Length, ♀ 4.6 mm. Width of head across eyes 1.6 mm.

Color: This little species is quite striking in appearance. The frons and vertex of the head are orange-yellow, while the rear margin behind the eyes is black. Pronotum and hemelytra are solid mahogany brown, approaching black, except for an orange-yellow half moon-shaped spot at the outer distal angle of the corium. The left membrane is straw colored while the right is dark. The embolium and venter smoky to black; the legs dark brown. As viewed from above, the species very closely resembles **Heterocorixa nigra** Hungerford.

Structural characteristics: Head three-fourths as long as the pronotal disk. Postocular space at least four times as broad as the diameter of an eye face. Interocular space narrower than the width of an eye. Vertex not produced. Face covered with long hairs. Beak reduced, without sulcations. Antennal segments: 1 : 2 : 3 : 4 : : 8 : 12 : 30 : 18 ♀.

Breadth to length of the pronotal disk as 100 : 45. No median longitudinal carina on disk. The claval pruinose area about half as long as the postnodal pruinose area, and the distance between the shining basal angles of the clavus and corium compared to the total length of the claval pruinose area from the claval angle as 1:2:½. (In other **Cymatia** spp. this ratio at least as great as 1 : 4. See plate.)

Lateral lobe of prothorax elongate, apex broadly rounded. Mesoepimeron narrow with osteole near its tip; base of mesoepimeron inflated, almost concealing the lateral prothoracic lobe. Metaxyphus small, broader than long.

Front leg of female: pala with six long lower palmar hairs (or sieve hairs), seven short upper palmar hairs, and seven long dorsal hairs; palar claw long and slender. Tibia with one or two short apical hairs. Femur pilose on basal third; distal two thirds armed with two long ventral spines and two short ones. (See plate.) Proportions of segments of front, middle, and hind legs as follows:

Front leg: femur : tibia : pala : claw : : 100 : 32 : 100 : 64.
Middle leg : femur : tibia : tarsus : claws : : 100 : 52.4 : 36.9 : 22.3.
Hind leg: femur : tibia : tarsus 1 : tarsus 2 : : 100 : 87.5 : 105.3 : 52.3.
Basal portion of hind femur pubescent ventrally for more than half its length;

*Contribution from the Department of Entomology, University of Kansas, Lawrence, Kansas.

distal glabrous portion with eight to ten scattered stout pegs ventrally and two or three dorsally.

Female abdomen with penultimate ventral lobe broadly rounded medianly, and with the anal lobes notched on their inner margin (see plate).

Comparative notes: The color pattern and the shape and comparative measurements of the claval pruinose area will separate this little species from other **Cymatia.** Structurally, the female is closest to **Cymatia apparens** (Distant) from which it may be distinguished by the above characters.

Location of types: Described from ♀ holotype labeled: "Australia, Prince of Wales Island, Febr. 15, 1939, R. G. Wind." This specimen purchased from R. G. Wind and now in the Francis Huntington Snow Collections, University of Kansas.

Key to **Cymatia** Flor

1. Claval pruinose area short, the distance between the shining basal angles of the clavus and corium compared to the length of the pruinose area from the claval angle as 1 : 2½. Color solid black (or very dark brown) with pale spot at outer angle of corium, and left membrane pale ..... **C. nigra** n. sp.
   Claval pruinose area long, the distance between the shining angles of clavus and corium compared to the length of the pruinose area from the claval angle at least as great as 1 : 4. Color pattern, if solid, then pale 2

2. Small species, less than 4.5 mm. long. Pronotal disk four times as broad as long ..... **C. coleoptrata** (F.)
   Species more than 4.5 mm. long. Pronotal disk about twice as broad as long 3

3. Pronotum and hemelytra covered with fine reticulation of brown lines; with short stout pegs all over the ventral shining portion of hind femur; male without a right clasper ..... **C. rogenhoferi** (Fieb.)
   Pronotum usually without brown markings or with only faint cross bands. Hemelytral pattern with more or less definite brown bars on clavus and brown spots on corium. With only a few stout pegs on ventral shining portion of hind femur. Males possessing a right clasper 4

4. Anterior margin of head not produced. Corial pattern in moderately distinct longitudinal series ..... **C. apparens** (Dist.)
   Anterior margin of head produced. Corial pattern not as above 5

5. Interocular space narrower than or about equal to the width of an eye. Rear margin of last ventral abdominal segment of female normal. Right clasper of male a broad plate ..... **C. bonsdorffi** (C. Sahlb.)
   Interocular space considerably broader than the width of an eye. Rear margin of last ventral abdominal segment of female quadrately produced. Right clasper of male narrow in distal half **C. americana** Hussey

EXPLANATION OF PLATE

Fig. 1. **Cymatia nigra** n. sp.; front leg of female.

Fig. 2. **Cymatia nigra** n. sp.; venter of hind femur.

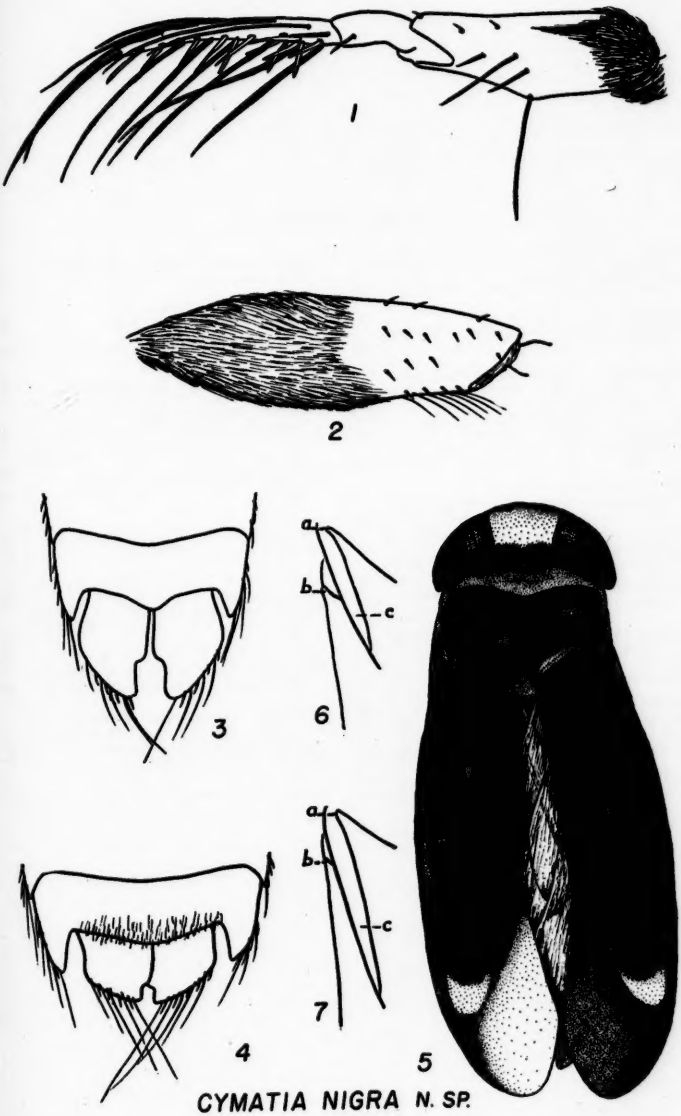
Fig. 3. **Cymatia apparens** (Dist.); last three ventral abdominal segments of female.

Fig. 4. **Cymatia nigra** n. sp.; last three ventral abdominal segments of female.

Fig. 5. **Cymatia nigra** n. sp.; dorsal aspect.

Fig. 6. **Cymatia nigra** n. sp.; lateral view of base of left hemelytron.
(a) Pigmented, shining basal angle of clavus.
(b) Pigmented, shining basal angle of corium.
(c) Claval pruinose area.

Fig. 7. **Cymatia apparens** (Dist.); lateral view of base of left hemelytron.
(a) Pigmented, shining basal angle of clavus.
(b) Pigmented, shining basal angle of corium.
(c) Claval pruinose area.



CYMATIA NIGRA N. SP.

INDEX—VOLUME 20

Aphid, A New Maple, and Some Aphid Records 24
Artemisaphis artemisicola (Williams) 26

Beamer, R. H., Article by 58
Butterflies, Notes on Kansas, with Description of a New Subspecies 93

Chalaenius (Coleoptera-Carabidae), An Undescribed Eversible Gland in the Larvae of 142
Chu, H. F., Article by 154
Corixidae, A New Genus of 93
Cymatia, A New Species from Australia 154

Dean, George A., Article by 41
Delphacodes, Some New Species of, with Two Old Ones (continued) 58
Diptera, New Genera and Species of Muscoid 15
Diptera, New North American Muscoid 95
Dorilaidae (Pipunculidae-Diptera), Notes and Descriptions of 146

Grasshopper, Injury to Raspberry by a Meadow 86
Grouse Locusts, The 127
Grundemann, Albert W., Article by .. 77

Hayes, William P., Article by 142
Hardy, D. Elmo, Articles by 1, 72, 146
Hill, Roscoe E., Article by 88
Hungerford, H. B., Articles by 93, 154

Kelly, E. G., Article by 41
Knowlton, George F., Articles by 24, 26

Leptoteromyia (Asilidae-Diptera), The Genus 72

McGuire, J. U., Article by 1
Miner, Floyd D., Article by 86

Nabours, Robert K., Article by 127

Penner, Lawrence R., Article by 30
Pentagramma, Some Notes on the Genus, and Four New Species (Homoptera-Delphacidae-Asiracinae) .. 30
Psyllid Outbreak of 1938 in Nebraska, An Unusual Weather Sequence Accompanying the 88
Ptiolina (Rhagionidae-Diptera), The Nearctic 1

Reinhard, H. F., Articles by 15, 95
Roberts, R. S., Article by 26

Sanderson, Milton W., Article by 27
Smith, Roger C., Article by 41
Stilicolina Casey (Coleoptera, Staphlyinidae), The North American Species of 27
Stallings, Don B., Article by 93
Summary, The Sixteenth or 1946 Annual Insect Population of Kansas 41

Triatoma sanguisuga (LeConte) in Kansas, (Reduviidae, Hemiptera), Studies on the Biology of 77
Turner, J. R., Article by 93

Index to Volume 20 158

72
1
86
127
30
30
88
1
5, 95
26
27
41
27
93
41
77
93
158

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TABLE OF CONTENTS

New North American Muscoid Diptera
H. J. Reinhard 117

The Grouse Locusts
Robert K. Nabours 127

An Undescribed Eversible Gland in the Larvae of **Chlaenius** (Coleoptera, Carabidae)
William P. Hayes and H. F. Chu 142

Notes and Descriptions of Dorilaidae (Pipunculidae, Diptera)
D. Elmo Hardy 146

A New Species of Cymatia from Australia
H. B. Hungerford 154

Index to Volume 20 158

....117

....127

....142

....146

....154

....158